



Active Watering Systems for Food Production

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Food Production

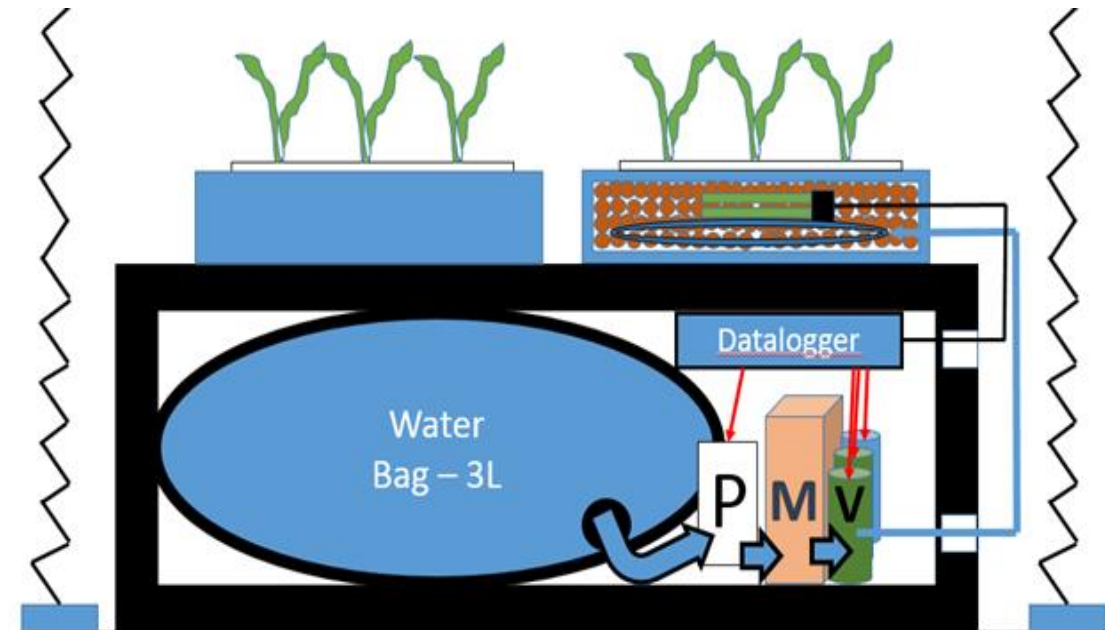
- Large Scale – Scale from Experimental to Production
 - 50 g salad per day for Crew = 6
 - 1 m² Planting area
- Performance criteria:
 - Productivity – maximal
 - Consistency – repeatable
 - Crew Time - minimal

Active Watering Systems for Food Production

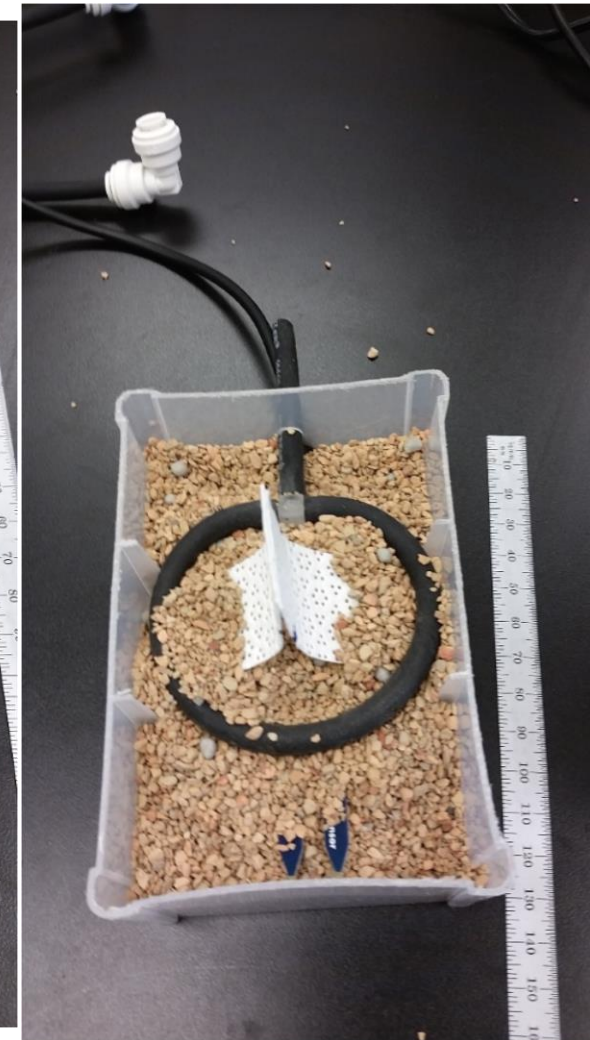
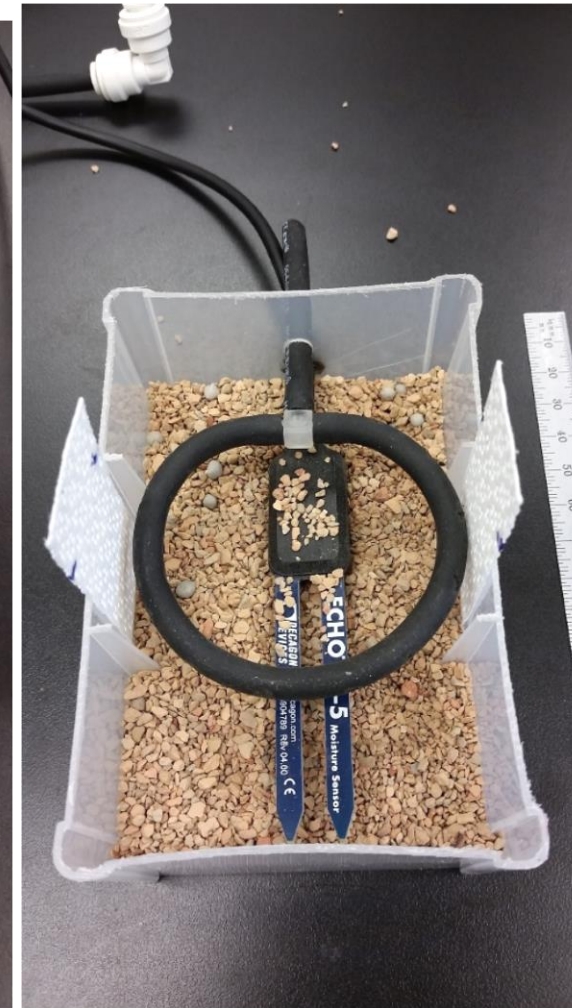
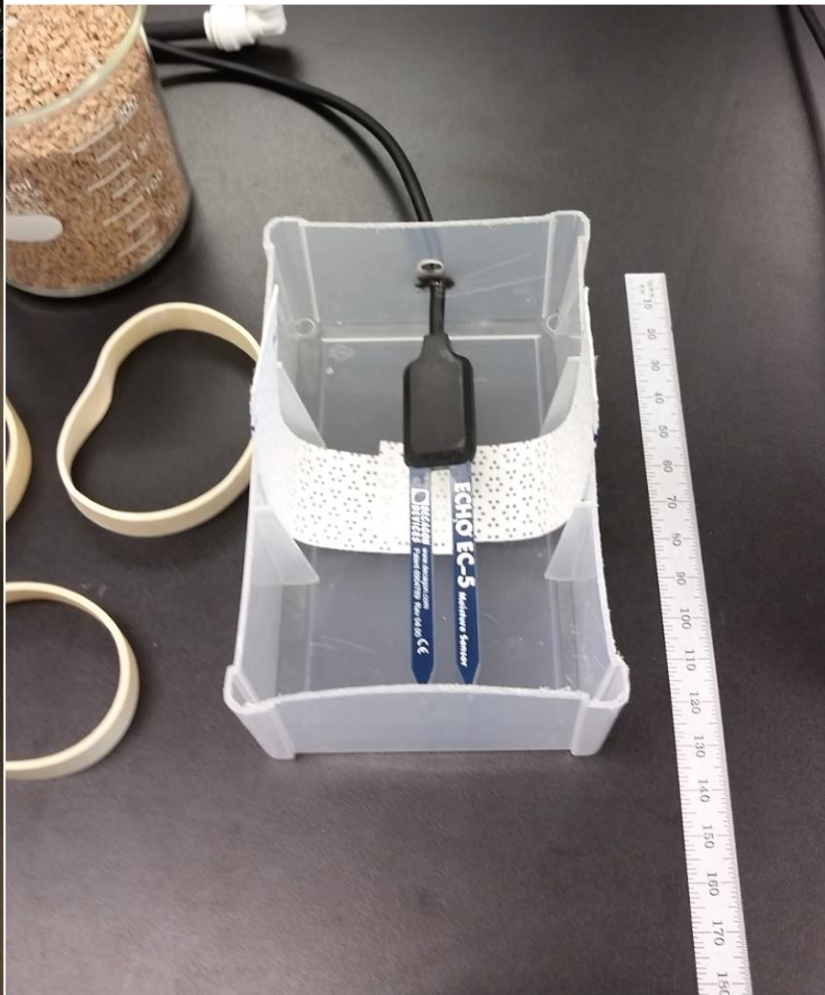
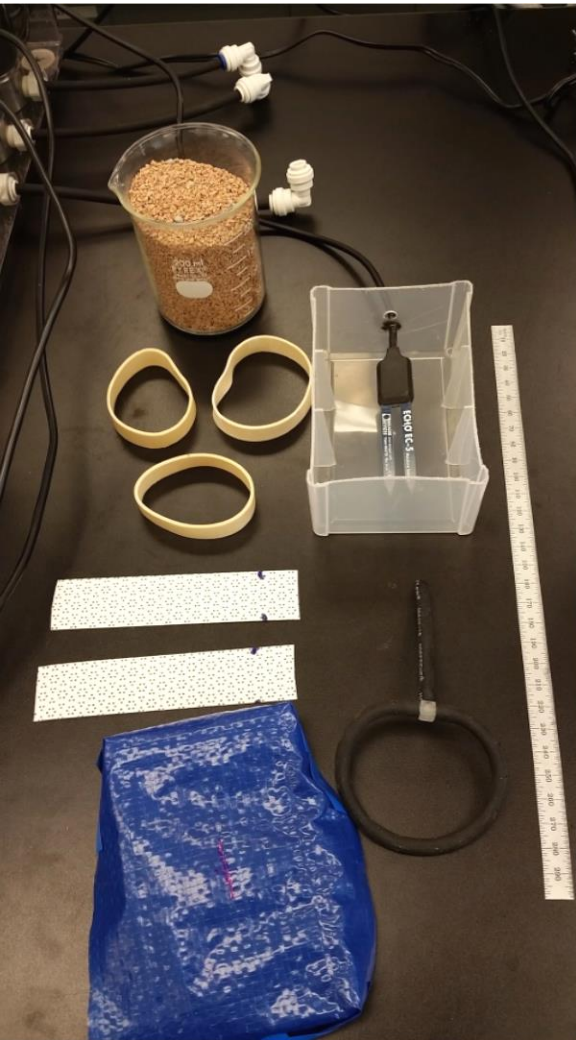
- Hydroponic – Surface Systems – TRL 7
- Aeroponic – Microgravity – TRL 5
- On-Demand Watering – Microgravity – TRL 9
- Systems:
 - Require Power
 - Employ Pumps and Solenoids
 - Reduce Crew Time

Active Watering System for Veggie

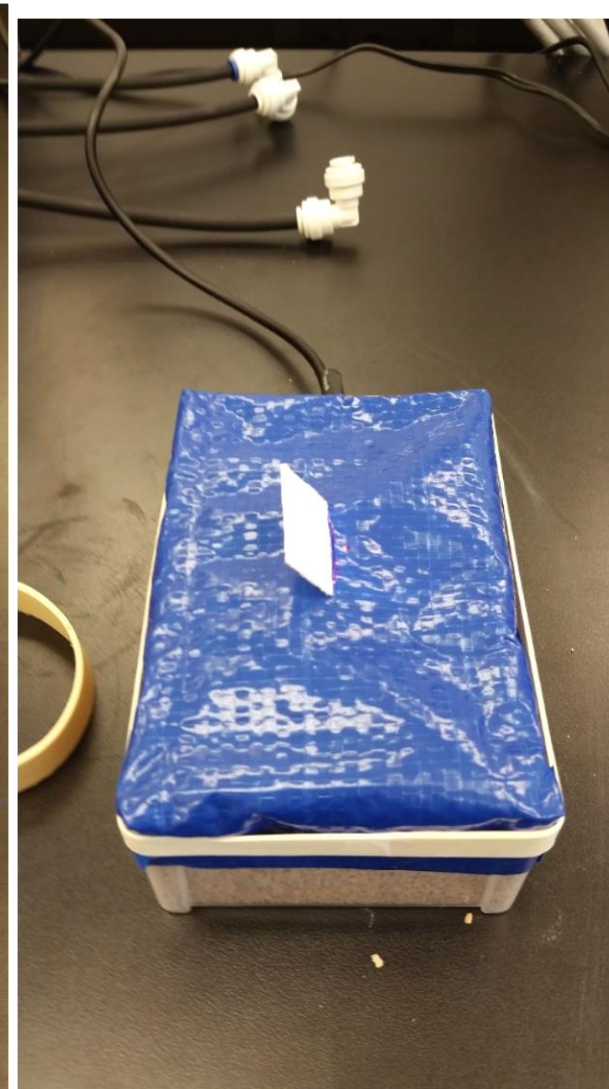
- Uses power – 10 W
- Automated operation - Water on-demand
- Additional resources – Laptop , sensors, pumps
- How robust is the system?
- Can it be scaled?



Pillow Assembly



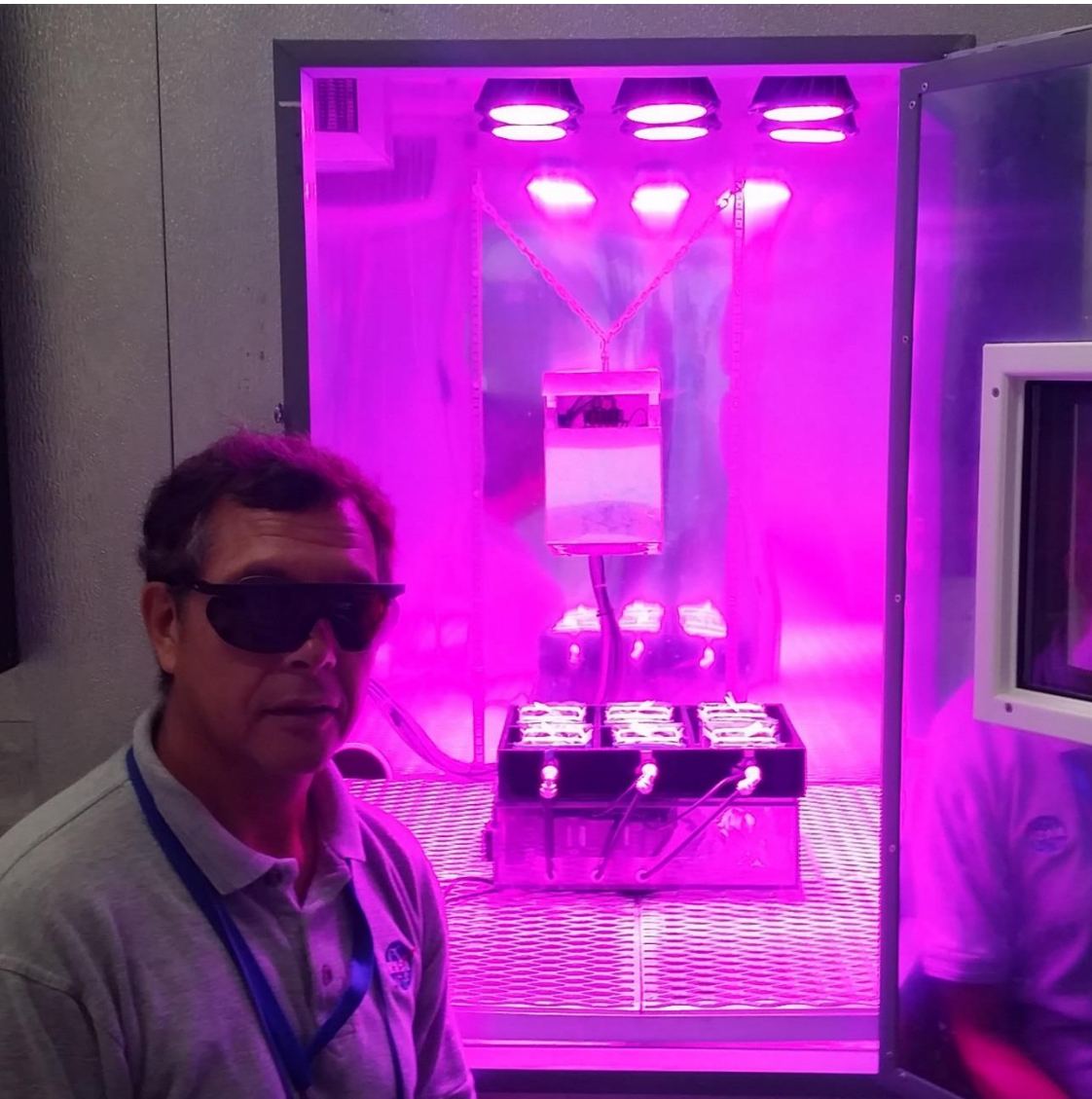
Pillow Assembly



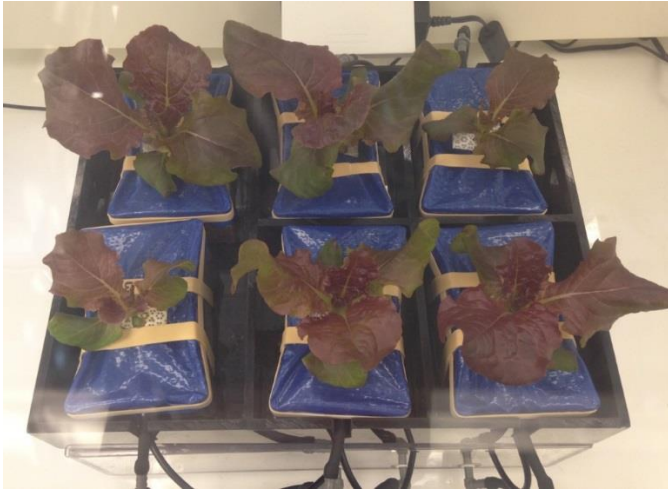
Planting



Chamber Study



Results



Goal:
Produce salad crops to
supplement crew diets
With fresh vegetables

Productivity

Germination	- 100%
Head Mass	- Edible Fresh Weight
Hydroponic	- 80-100 g
Veggie	- 25-30 g
Active	- 40-60 g
Power Use	- 10 W continuous



Active Watering Systems – Microgravity Issues

- Reduce Consumables – Media must be reusable
- Provide Nutrients – Obtain from waste
- Optimize to prevent secondary effects of microgravity
- Reduce mass – compact designs
- Optimize reliability and robustness

Conclusions

- Active systems
 - Automated to reduce crew time
 - Ensure consistent Productivity
- Issues – handling leaks, refilling water bag
- Future Work
 - Develop reusable media
 - Develop Flight rated designs based on current designs